APPLIED COGNITIVE PSYCHOLOGY
Appl. Cognit. Psychol. **21**: 951–961 (2007)
Published online 30 October 2006 in Wiley InterScience
(www.interscience.wiley.com) DOI: 10.1002/acp.1307

Beyond Unusual? Examining the Role of Attention in the Weapon Focus Effect

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SUMMARY

The current study examined whether the weapon focus effect could be accounted for in terms of stimulus novelty. Participants viewed a slideshow of a simulated event while attending to a secondary task. In the critical slide, the target was shown holding a threatening object (weapon condition), a novel object (unusual condition) or a neutral object (control condition). Reaction times on the secondary task were impaired in the weapon and unusual conditions. Participants in the weapon condition had poorest recognition scores for the target's appearance when confidence was also taken into account. Results suggest that while both unusual and threatening objects command attention, the significance of a weapon can lead to impaired performance on less immediately informative aspects of a scene such as target appearance. Copyright © 2006 John Wiley & Sons, Ltd.

Offences involving weapons, and in particular firearms, are on the increase (Hepburn & Hemenway, 2004; Simmons & Dodd, 2003). Although some field research suggests that the emotional arousal associated with violent witnessing conditions may actually serve to benefit memory (e.g. Yuille & Cutshall, 1986, but see Wright, 2006), eyewitness experts have tended to favour the view that incidents involving the presence of a weapon will have a negative impact on eyewitness performance (Kassin, Tubb, Hosch, & Memon, 2001). This phenomenon has become known as the *weapon focus effect* (Loftus, Loftus, & Messo, 1987). Research suggests that the presence of a weapon adversely affects subsequent eyewitness recall performance such that memory for details such as the perpetrator's facial characteristics and clothing is impaired (e.g. Cutler, Penrod, & Martens, 1987; Kramer, Buckhout, & Eugenio, 1990; Loftus et al., 1987; Maas & Kohnken, 1989; Pickel, French, & Betts, 2003; Stebley, 1992). One explanation is that increased arousal (or stress) due to the presence of a weapon reduces attentional capacity. Increased attention is paid to the weapon while peripheral cues are ignored or filtered (Loftus, 1980; Macleod & Mathews, 1991).

A recent meta-analytic review of the effects of stress on eyewitness memory by Deffenbacher, Bornstein, Penrod, and McGorty (2004) sheds light on the apparent contradictory findings by hypothesizing two different modes of attentional control on memory performance. They found that high levels of stress impair the accuracy of eyewitness recall and identification, but that the detriment depends on the response mode

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elicited by the stress manipulation. The authors propose that some emotion manipulations generate an 'orienting' response while others generate a 'defensive' response (Deffenbacher, 1994; Deffenbacher et al., 2004; see also Klorman, Weissberg, & Wiesenfeld, 1977; Sokolov, 1963). Deffenbacher et al. (2004) argue that the orienting response leads to enhanced memory for 'informative aspects' of a scene but that the defensive response can lead to either enhanced memory or significant memory impairment depending on other cognitive and physiological factors. The orienting response is typically elicited by novel stimuli while the defensive response can be facilitated by unexpected or intense stimuli (Isen, 1984).

The meta-analysis provides a theoretical justification and framework for examining novelty alongside emotion for the weapon focus effect. Studies of the weapon focus effect exploring the role of novelty take the view that the appearance of a weapon may be very unexpected in many, if not all, witnessing contexts (e.g. Mitchell, Livosky, & Mather, 1998). It could be argued that a weapon might well constitute a surprising or unusual object when encountered, for instance, during a routine trip to a fast food restaurant (cf. Loftus et al., 1987). Following Deffenbacher et al.'s (2004) rationale, a weapon could be construed a very 'informative aspect' of a given scene if attention is drawn to the processing of the object either because it is unusual or contains critical information about the environment. It follows that attention paid to periphery may be reduced.

Recent examinations of the weapon focus effect have tended to suggest that the presence of a weapon may not be a necessary prerequisite of the weapon focus effect (e.g. Kramer et al., 1990; Maas & Kohnken, 1989; Mitchell, Livosky, & Mather, 1998). For example, Pickel (1998) investigated the roles of unusualness and threat as possible causes of the weapon focus effect whereby witnesses viewed a scene that incorporated an object deemed to be high or low in terms of threat and unusualness. Pickel (1998) showed that stimulus unusualness impaired recall for descriptive information about the target suggesting that the so-called weapon focus effect may, in fact, be due to the unexpected nature of the weapon rather than any threat associated with it. In subsequent research, Pickel (1999) concluded that 'weapons often surprise eyewitnesses by appearing out of context, where they are unexpected' (Pickel, 1999, p. 309). Witnesses viewed a video depicting an armed man who interacted with a woman, either at a shooting range (in-context scenario) or baseball match (out-of-context) scenario. In a second study, the context was also manipulated such that the target person in different conditions was dressed either as a policeman (weapon in-context) or as a priest (weapon out of context). Findings indicated that less accurate descriptions of the target were provided by witnesses when the action took place in the baseball ground—an unexpected setting for a weapon—than when the weapon appeared in the more congruent context of a shooting range. One possible explanation for these findings is that unusual objects command additional visual attention simply because they are unusual and this drain on attentional capacity results in poorer recall performance for scene features, including target characteristics, irrespective of threat and emotional arousal involved.

Have previous examinations of the weapon focus effect provided an over-simplified account of the effect by suggesting that the weapon focus effect might actually be no more than a result of a reduction of attentional resources due to the novelty of a weapon? It has been shown that distinctive stimuli will typically produce an orienting response and that the magnitude of the response is associated with the novelty and significance of the stimuli (Gati & Ben-Shakhar, 1990). While both weapons and unusual items in a witnessed scene may elicit an orienting response, we sought to determine whether the weapon focus effect

DOI: 10.1002/acp

could be fully accounted for in terms of stimulus novelty using a new approach for disentangling responses to unusual and threatening objects.

Participants viewed a slide sequence that included a critical slide in which the target held either a gun (threatening object, weapon condition), a feather duster (novel object, unusual condition) or a wallet (neutral object, control condition). While watching the slides, participants were required to attend to a secondary task (a choice reaction time task) that appeared on the same screen. This secondary task was used to compare the attentional demands experienced by witnesses when exposed to a critical slide with a threatening object (weapon condition), a novel object (unusual condition) and a neutral object (control condition). It was hypothesized that reaction times to the critical slide should be slower in the experimental conditions ('weapon' and 'unusual' condition) as opposed to the control condition due to stimulus novelty. If the effect is due to the threat associated with a weapon, then reaction times should be slower in the weapon condition.

METHOD

Design and participants

Forty-five U.K. college students (21 male, 24 female), aged 20–43 ($M = 25.18$, $SD = 5.12$) years were tested individually. Participants were randomly assigned to the weapon condition, the unusual condition or the control condition. Each session lasted approximately 40 minutes.

Materials

A computer slide sequence (13 slides) was generated using digital photographs. The slides depicted a sequence in which a male target enters a small grocery store (see Figure 1). In the critical slide (sequence position 11), the target is shown to have removed one of three objects from inside his jacket while inside the store: (i) a gun (weapon condition), (ii) a red, yellow and blue feather duster (unusual condition) or (iii) a man's fold-over dark leather wallet (control condition).

Centred horizontally within an 18 cm × 15 cm frame, each slide remained on screen for 4 seconds with a blank black slide appearing for 1 second between each event slide.

Recognition Phase	Slides		Description
Phase 1	1-5	Opening sequence	Exterior of the store
			Interior shots showing newspaper racks and cash till area.
Phase 2	6-10		Assistant in conversation with a female customer
			Open door of the store (from the inside) and the street outside
			Male target shown entering the store
Phase 3	11	Critical scene	Full frontal view of target holding critical object
Phase 4	12	Closing sequence	Target shown leaving store (from behind)
Phase 5	13		Target proceeding along the street outside

Figure 1. Slide sequence for stimulus event

DOI: 10.1002/acp

Underneath the slide frame, a second smaller frame (8 cm × 2 cm) appeared in which a two-digit number sequence appeared. Each number remained on screen for 400 milliseconds with a break of 300 milliseconds between numbers. On average, five randomly generated numbers appeared per slide. The computer programme was designed such that the numbers were randomly generated except that only one odd number appeared during the presentation of the critical slide in each condition.

Procedure

Details of the study prior to attendance were kept to a minimum. Participants were informed that the research concerned 'individual differences in perception' and were randomly assigned to one of the three experimental conditions. On arrival at their session, participants were seated at a computer in an individual test cubicle and provided with a test booklet. Participants were provided with a brief description of the task and details of the spatial organization of the stimulus on screen. They were instructed to watch the stimulus slides as closely as possibly and, at the same time, to monitor the numbers appearing in the frame underneath the main slide frame. They were required to press a designated response key ('O') on the keyboard as quickly as possible when an odd number appeared in the box. Participants were informed that this was a reaction time task and asked to respond as quickly as possible, while still paying attention to details in the slides. After viewing the slides and completing the simultaneous reaction time test, participants completed a 20 minute filler task involving 80 mathematical problems of varying difficulty level.

The main memory measure comprised 22 forced-choice recognition questions (Yes, No) for details of the slides (including response confidence ratings; 1 = Not at all confident, 11 = Very confident). Participants were also required to provide free recall accounts of the object appearing in the critical slide. The memory statements were divided into five sequence segments (Table 1; see Bornstein Liebal, & Scarberry, 1998, for similar segmenting of an event sequence). In the final section of the response booklet, participants were asked what they thought the man was doing in the store. On completion of the testing booklet, participants were paid, thanked and debriefed.

RESULTS

The main aim of the current study was to investigate whether the weapon focus effect might be accounted for in terms of novelty and an associated reduction in attentional capacity. Effect sizes are reported as recommended in Wright (2003).

Choice reaction times

A choice reaction time task was used to monitor participants' responses when a weapon, an unusual object or a control object appeared in a critical slide in a witnessed scene. It was predicted that reaction times would be slower for participants in the experimental conditions viewing either a weapon or unusual object in the critical slide. Prior to a log transformation, the reaction time data were skewed (1.10, $SE = 0.34$). Post-transformation, skewness was reduced to 0.26. Analysis of variance indicated a significant difference between the log-transformed reaction times, $F(2,39) = 8.80$, $p = 0.001$, $\eta^2 = 0.32$. *Post hoc* testing indicated that transformed reaction times to the critical slide for the control

DOI: 10.1002/acp

Table 1. Sequence of recognition test items

	Weapon		Unusual		Control				
	M	*SD*	*M*	*SD*	*M*	*SD*	*F*	*p*	η^2
Phase 1 *M* Score	2.80	2.91	2.17	2.92	1.31	2.55	1.07	0.35	0.05
Phase 2 *M* Score	1.87	2.60	4.58	3.64	2.36	2.10	3.78	0.03	0.16
Phase 3									
Q.9. The man who entered the shop wore a black jacket?	6.00	4.51	5.80	5.77	0.93	7.98	3.16	0.05	0.13
Q.10. The man was wearing a navy baseball cap?	3.13	8.58	7.40	4.52	9.00	2.51	4.12	0.02	0.16
Q.11. The man had a goatee beard?	0.47	6.53	3.20	7.83	5.36	6.27	1.82	0.17	0.08
Q.12. The man was wearing a red t-shirt?	−1.13	6.78	3.40	7.34	1.36	8.32	1.38	0.26	0.06
Q.13. The man was carrying a rucksack over his shoulder?	1.93	4.28	2.80	6.58	0.71	6.74	0.45	0.64	0.02
Q.14. The man wore a watch on his right hand?	−0.47	2.72	0.67	5.25	1.71	3.49	1.10	0.35	0.05
Q.15. The man was wearing sunglasses?	1.80	7.95	5.73	6.59	8.21	5.26	3.37	0.04	0.14
Q.16. The man had long hair that was tied back?	5.40	8.46	6.73	8.19	9.80	1.66	1.62	0.21	0.07
Phase 3 *M* Score	2.14	2.12	4.47	3.23	4.75	1.94	4.81	0.01	0.20
Phase 4 *M* Score	3.38	1.39	1.65	2.47	1.11	7.38	1.04	0.36	0.05
Phase 5 *M* Score	1.20	3.49	5.23	4.81	2.80	4.13	3.54	0.04	0.14

condition ($M = 2.65$, $SD = 0.21$) were significantly faster than for the other two experimental groups (see Figure 2). Reaction times did not differ significantly between the weapon condition ($M = 3.18$, $SD = 0.37$) and the unusual condition ($M = 3.06$, $SD = 0.37$).

Recognition accuracy and confidence

Of greatest interest to the weapon focus question is performance by condition with regard to target appearance (Phase 3). The overall accuracy rate for Phase 3 was calculated for each condition. The correct response rates were as follows: Weapon: 59%, Unusual: 70%, Control, 82%. To determine whether there was a significant difference in accuracy between conditions a score of −1 was assigned to all incorrect responses and a score of +1 was assigned to all correct responses for each Phase 3 item. These scores were then summed to obtain a total correct score for Phase 3. Analysis indicated a significant difference between the conditions, $F(2,43) = 3.82$, $p = 0.03$, $\eta^2 = 0.16$. *Post hoc* tests indicate that scores in the weapon condition ($M = 1.53$, $SD = 2.32$) were significantly different from scores in the control condition ($M = 4.00$, $SD = 2.04$) but did not differ significantly from scores in the unusual condition ($M = 2.87$, $SD = 2.77$).

However, for this critical phase, there was a significant difference in rated confidence between experimental groups, $F(2,43) = 3.95$, $p = 0.02$, $\eta^2 = 0.16$. *Post hoc* tests indicate that participants in the weapon condition ($M = 6.22$, $SD = 1.25$) were significantly less confident in their recognition responses than participants in either the unusual ($M = 7.53$, $SD = 1.54$) or control condition ($M = 7.54$, $SD = 1.61$).

DOI: 10.1002/acp

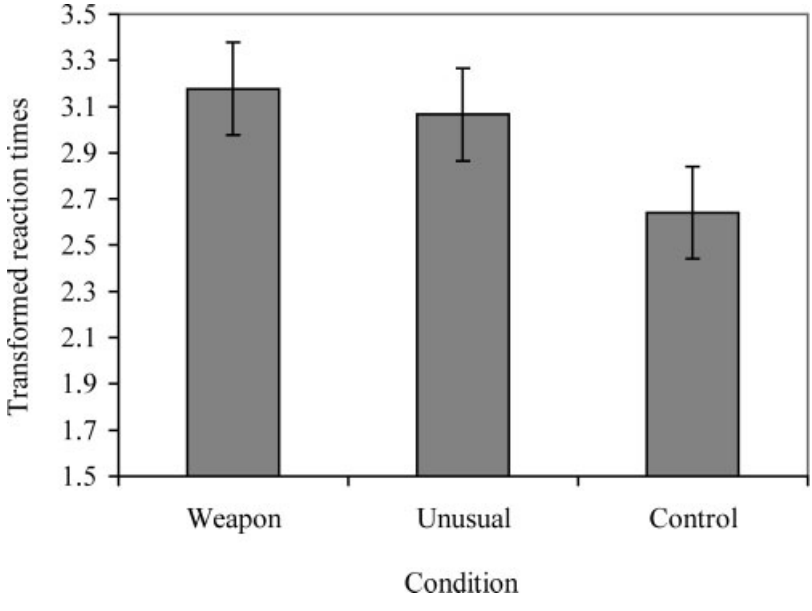

Figure 2. Reaction time responses, following log transformation, by condition (Error bars represent 95% confidence intervals)

Given these differences in recognition and certainty, a more sensitive measure for recognition items was derived by combining accuracy and confidence scores (for previous research using this measure see Hope, Memon, & McGeorge, 2004; Jones & Kaplan, 2003; Kassin & Sommers, 1997; Wright & Livingston-Raper, 2001). Each recognition response (Incorrect: -1, Correct: $+1$) was multiplied by its corresponding confidence score to create a scalar value from -11 (maximum confidence in an incorrect response) to $+11$ (maximum confidence in a correct response). The mean scores for each recognition phase are presented in Table 1. The recognition performance in the weapon condition did not differ from the control group for Phase 1, Phase 2, Phase 4 or Phase 5. Participants in the unusual condition performed better than those in the weapon or control group in Phase 2 and Phase 5.

In Phase 3 and most relevant to the weapon focus question, there were significant differences in scores for three target appearance recognition items with participants in the weapon condition producing lower scores.

All scores for Phase 3 were averaged to obtain a mean score for Phase 3, which comprised critical questions concerning the appearance of the target. Analysis indicated an overall significant difference in scores by condition, $F(2,43) = 4.81$, $p = 0.01$, $\eta^2 = 0.20$. *Post hoc* tests indicated that, overall, participants in the weapon conditions ($M = 2.14$, $SD = 2.12$), scored significantly lower than participants in the unusual ($M = 4.47$, $SD = 2.23$) or Control ($M = 4.75$, $SD = 1.94$) condition. Scores in the unusual condition did not differ significantly from those in the control condition. Scores on this measure for all recognition items appear in Table 1.

Object recall

There was a significant association between condition and recall of the critical object, χ^2 $(2, N = 45) = 4.17$, $p = 0.04$, $\phi = 0.33$. In the weapon condition, 93% correctly recalled

DOI: 10.1002/acp

that they had seen the target take a gun from inside his jacket; in the unusual condition, 67% correctly recalled the object (feather duster) correctly; in the control condition 60% correctly recalled the wallet. There was a significant difference in the number of correct object descriptors generated in free recall, $F(2,44) = 6.76$, $p < 0.01$, $\eta^2 = 0.24$. *Post hoc* tests showed that participants in the weapon condition ($M = 2.20$, $SD = 1.21$) provided significantly more details about the object than participants in the unusual ($M = 1.00$, $SD = 0.85$) and the control condition ($M = 0.93$, $SD = 1.09$).

Scenario interpretation

In all conditions, plausible interpretations of the man's behaviour were generated. Participants in the unusual condition had difficulty generating a consistent explanation. Eighty-seven per cent of participants in the weapon condition said the sequence was an armed robbery while 93% participants in the control condition (in which the target takes out a wallet) said that the man was simply making a purchase. Participants in the unusual condition gave a variety of plausible explanations to account for the appearance of a feather duster in the critical slide. Examples include that the man was offering to clean the store that he was asking the assistant if he stocked a similar item, that he was attempting to sell the duster and that he was playing a trick on the assistant. No participants in either the unusual or control condition interpreted the scenario as a robbery.

DISCUSSION

The current study sought to determine whether the weapon focus effect could be fully accounted for in terms of stimulus novelty. We devised a new approach to disentangling responses to neutral, unusual and threatening objects. Participants watched a slide sequence while having to attend to a secondary task. Performance scores on the secondary task measured the attention demand associated with the critical slide. When a novel item (either threatening or unusual in nature) appeared in the critical slide, participants had slower reaction times on the secondary task relative to control participants who did not encounter a novel item. This finding is interesting as it suggests that viewing either a threatening or unusual novel object commands more visual attention than viewing an in-context neutral object. Thus, these results confirm that exposure to a novel item facilitates attentional drain from concurrent task.

However, differences in memory performance suggest that there may be more to the weapon focus effect than a simple orienting response to a novel object. While participants who viewed the weapon sequence provided more accurate and detailed descriptions of the object they had seen, other aspects of performance were impaired for this group. Participants in the weapon condition were less accurate than control participants and their combined accuracy/confidence scores were lower than both control and unusual group participants. These results fit well with previous findings in the weapon focus literature (e.g. Cutler, Penrod, & Martens, 1987; Kramer, Buckhout, & Eugenio, 1990; Stebley, 1992). The results are also consistent with findings reported by Loftus, Loftus, and Messo (1987) who demonstrated that participants exposed to a weapon made more fixations of longer duration on the gun (than the non-threatening control alternative) and were less accurate in their responses to (multiple-choice) questions about the target. Importantly, these results suggest that memorial effects elicited by exposure to a weapon may be subtler

DOI: 10.1002/acp

than identified in previous studies involving unusual stimuli. Performance on the reaction time task was not significantly different between the weapon and unusual groups and reaction times for both conditions were impaired relative to the control group. However, in terms of recognition accuracy for the target's appearance, participants in the weapon condition were impaired relative to those in control groups and were also less confident in their responses concerning the target (than both control and unusual participants) but yet recalled significantly more details about the critical object—a gun.

A possible interpretation of this finding might be that while unusual objects draw additional visual attention (hence the reaction difference between the unusual and control condition), there may be a further conceptual dimension present in the weapon condition, which leads to the additional deficits for target appearance observed in the current study. How might such a suggestion fit with existing theoretical accounts?

Researchers favouring the view that the weapon focus effect can be explained in terms of object novelty or unusualness generally argue that additional visual attention is required to process an unusual or out of context object (e.g. Pickel, 1998; Mitchell et al., 1998). However, although succeeding in generating a similar effect to the traditional weapon focus effect with unusual objects, these studies have not implemented a measure of 'attention drain' to investigate differences systematically between attentional processes in respect of a weapon or an unusual object. In line with standard conceptualizations of attentional processes, the more cognitively demanding a task becomes, the more likely interference will be observed on concurrent task (e.g. Reisberg, 1983). Pickel, French, and Betts (2003) in their examination of cross-modality within the weapon focus effect suggest that when a weapon is present it draws resources not only from the visual attention pool but also more general attention resources. As a result, the presence of a weapon may interfere with the processing of other forms of information.

Pickel's (1999) synopsis of the process by which visual attention might be drawn to an unusual object stems from Loftus and Mackworth's (1978) multi-level account of scene processing and relies heavily on existing script and schema theory (Abelson, 1981; Schank & Abelson, 1977). This account proposes that when viewing a scene, the gist of the scene is initially extracted and activates an internally held schematic representation of the situation not necessarily based on actual experience (Greenberg, Westcott, & Bailey, 1998; Holst & Pezdek, 1992). This script 'serves as a guide for making inferences about what is happening, what to expect next and how to act' (Greenberg, Westcott, & Bailey, 1998, p. 686). Consequently, unexpected, unusual and script inconsistent objects command additional attention and take extra effort to process (Pickel, 1999).

However, this approach does not provide a satisfactory account of the weapon focus effect. Holst and Pezdek (1992) and Greenberg, Westcott, and Bailey (1998) found evidence to suggest that robbery scripts can be generated with high levels of agreement without actual experience of a robbery situation. In the current study, the majority of participants in the weapon condition identified the sequence as an armed robbery even though no actual theft was shown during the slide sequence. Thus, it seems likely that a robbery script consistent with the appearance of a weapon was activated for participants in the weapon condition. Nonetheless, participants in the weapon condition, despite their hypothesized easier access to an appropriate script, did not react faster than participants in the unusual condition. Furthermore, these participants demonstrated greater memorial impairment than participants in the unusual condition.

Accounting for this impairment for witnesses in the weapon condition requires, perhaps, a re-conceptualization of 'threat'. It seems likely that participants in both the weapon

DOI: 10.1002/acp

condition and unusual condition experienced an orienting response. Participants in the weapon condition had enhanced memory for 'informative aspects' (i.e. the gun informing them that threat was present/a crime was taking place) of the critical scene (cf. Deffenbacher et al., 2004). However, the significance (cf. Gati & Ben-Shakhar, 1990) of the weapon in the scene led to impaired performance on less immediately relevant aspects such as target appearance while this was not the case for participants in the unusual condition. Thus, it may be that a scene involving a weapon is more informative and contains various levels of 'information priorities' (Heuer, Reisberg, & Rios, 1997, p. 119). If this is the case, then the weapon focus effect might arise because the weapon in itself constitutes a vital information source about what is happening in the scene (i.e. a crime or otherwise threatening event). When a robbery script is accessed, it may also trigger a warning system that indicates to the witness that what they are seeing is important—with the presence of a weapon adding that additional factor not generated for an unusual harmless object.

Thus, while the reaction time deficit for an unusual object (as opposed to a neutral control object) might be explained as a visual attention process with the unusual object acting as a script-inconsistent 'attention magnet' (Heuer, Reisberg, & Rios, 1997, p. 122), the deficit in the weapon condition may arise from a 'significance factor' associated with the weapon as a conceptually loaded target object. It may, of course, be the case that this 'significance factor' also contains emotional aspects, including fear reactions associated with the negative aspects of a weapon within a robbery script.

The finding that participants exposed to weapons are also less confident in their recognition of target-related items is also important. Previous studies (e.g. Pickel, 1998, 1999) have not typically assessed witness confidence yet the current results suggest that both accuracy and confidence are impaired for participants exposed to a weapon compared to control participants. Within the legal system, the confidence of a witness is critical. Research indicates that a confident witness will be perceived as more credible by jurors and as a consequence, have a greater impact on juror decision-making (Cutler, Penrod, & Dexter, 1990; Fox & Walters, 1986; Luus & Wells, 1994; Wells, Ferguson, & Lindsay, 1981; Whitley & Greenberg, 1986).

The current results suggest that it is not possible to compare the effects of the presence of a potentially lethal weapon to those produced by the presence of a non-lethal unusual object—irrespective of how unusual or out of context that object might be. Clearly, it is important to take context into account and Pickel's (1999) results demonstrate the importance of congruent and incongruent scenarios in the production of the effect. However, reducing the difference to simply one of unusualness may, in fact, be rejecting the most interesting part of the weapon focus phenomenon—the effect weapons have on us. We acknowledge, however, that there may well be other important effects of unusualness. In the current study, participants in the unusual condition performed better than other participants in one phase preceding and one phase subsequent to the critical phase. It is possible to speculate that the appearance of a novel object may trigger an orienting response, which, in the absence of threat, leads to a heightened awareness. Clearly, further examination of responses to unusual or novel stimuli is necessary.

The notion of a 'weapon focus' effect should not be abandoned—by either psychologists working in the eyewitness arena or the legal fraternity. Research is necessary to clarify the components of the effect. Disentangling the roles of emotion and novelty is critical, and may enable us to predict under what conditions a defensive or orienting response is likely to occur for a witnessed event. Theoretical consolidation with other areas established within psychology such as attention and human information

DOI: 10.1002/acp

processing may offer a significant contribution in establishing the phenomena as a legally reliable feature of eyewitness recall.

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